

Biodiesel production using calcium carbonate and other heterogeneous catalysts

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Traditional basic and acidic catalysts known to be effective for producing of methyl and ethyl esters of reactions are ineffective toward alcoholysis of ethylene glycol with soybean oil under similar reaction conditions. As a result of the deficiencies of these catalysts, a survey of alternative catalysts were evaluated. Satisfactory performance for several alcoholysis reactions was achieved with calcium carbonate catalysts albeit at higher temperatures, typically greater than 200°C. Higher reaction temperatures are not considered to be a problem for flow reactors where heat exchangers can be readily used to minimize energy costs. Similar results were obtained for carbonates of metals similar to calcium.

The metal carbonate catalysts effectively esterified free fatty acids found in fats and oils with no noticeable deactivation or soap/salt formation; although equilibrium limitations limited free fatty acid conversion. Reaction times of 18 min provided essentially complete conversion. No decrease in the activity of calcium carbonate was observed after weeks of utilization. The robust structure is suitable for used in packed-bed reactors. The catalyst used for the flow reactors was pulverized limestone. Limestone from two locations was tested and found to be effective. Catalyst removal requires only a screening process at the reactor discharge.

Processes based on metal carbonate catalysts would benefit from reusing the catalyst without by-product generation. Among the advantages of heterogeneous catalysts and flow processes based on heterogeneous catalysts are:

- ?? Substantial Reduction of Waste/Byproduct Generation
- ?? Savings on Catalyst Costs
- ?? Use of Recuperative Heating Reduces Heat Requirements as Compared to Batch Processes
- ?? Considerably Greater Increase in Reactor Throughput
- ?? Smaller Heat Exchanger Areas (condensers, heat addition)—Reduced Costs
- ?? Greater Ease of Automation and Continuous Processing Without Operator on Duty
- ?? Substantial Reduction in Initial Capital Costs Due To Above
- ?? Substantial Reduction in Operating Costs Due to Above
- ?? Reduction in Chemical Storage (catalyst, agents used to neutralize catalysts)

Plans are in progress for a field demonstration of the technology by the end of 2001. If successful, the goal will be to offer pre-fabricated mobile processes capable of a range of production capacities.